Does Rural Residence Affect Prenatal Care Access for Women in Oregon?

Beth Epstein

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This is to certify that I have examined this copy of a master's thesis by

Beth Epstein

and have found that it is complete and satisfactory in all respects,
and that any and all revisions required by the final
examining committee have been made.

Committee Members:

_____
Therese M. Grant

_____
Melissa Schiff

Date:_____

University of Washington

Abstract

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Chair of the Supervisory Committee:
Associate Professor Therese M. Grant
Psychiatry and Behavioral Sciences

Context: It is important to identify disparities between the perinatal health status of rural and non-rural dwelling women, to determine if specific subpopulations could benefit from new programs or intensification of current interventions. One accepted measure of perinatal health is initiation of prenatal care in the first trimester.

Purpose: Our objectives were to determine if rural women are less likely to access early prenatal care, and if rural women report more and/or different barriers to accessing early prenatal care, compared with their non-rural counterparts.

Methods: This study utilized an observational, cross sectional design based on data from the 2003 Oregon Pregnancy Risk Assessment Monitoring System (PRAMS). Rural Urban Commuter Access Codes (RUCA Codes) were appended, and used to categorize maternal residence as urban, large rural, or small/isolated rural. We performed logistic regression to evaluate whether category of residence, after controlling for other maternal characteristics, was associated with late initiation of prenatal care, estimating the odds ratio and 95% confidence intervals. Multivariate logistic regression was used to determine which maternal factors together would best predict late initiation of prenatal care. We explored the association of category of

residence with categories of barriers to prenatal care, using the Cochran-Mantel-Haenzel test of association (CMH) and its associated p-value.

Findings: There was no statistically significant association between category of residence and late initiation of prenatal care in crude or adjusted analysis. Women from large rural areas were more likely to be less than 18 years old, not married, to have less than 12th grade education, and to have had an unintended pregnancy, compared with women in either urban or small/isolated rural areas. In our multivariate model, the variables which together best predicted late initiation of prenatal care were: unmarried status (OR 2.09, 95% CI 1.32 to 3.32), maternal Hispanicity (OR 1.51, 95% CI 1.01 to 2.25), family income at or below 185% of the Federal Poverty Level (OR 1.73, 95% CI 1.02 to 3.01), and all categories of barriers, especially social/logistic barriers (OR 4.18, 95% CI 1.74 to 10.02). We found no association between category of residence and barriers to initiation of prenatal care.

Conclusions: Geographic category of maternal residence is not associated with late initiation of prenatal care or with barriers to initiation of prenatal care. Maternal risk factors for late initiation of prenatal care clustered in large rural areas, suggesting a possible new focus for maternal and child health programs. The strong association between social/logistic barriers and late initiation of prenatal care suggests that interventions must begin before pregnancy.

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INTRODUCTION

In the last decade there has been increased awareness of and interest in the determinants of the health of geographically defined subpopulations. There are, however, significant gaps remaining in our knowledge about how the perinatal health of women in rural Oregon compares to that of women living in more urban areas of the state. It is important to identify disparities between the perinatal health status of rural and non-rural dwelling women, in order to identify whether there are subpopulations within the state that could benefit from intensification of current interventions, increased coordination of services, or new programs.

One marker of perinatal health is utilization of prenatal care, with one of the accepted measures of quality being initiation of care in the first trimester.[1-5] Although the weight of recent evidence suggests that the role of early and adequate prenatal care in improving rates of preterm birth and low birth weight is not as significant as had been hoped in earlier years, it is still widely agreed that access to early and adequate prenatal care is an important part of our ability to assure maternal and infant well being.[6-8] Access to prenatal care may serve as a proxy measure for access to health care in general, and has been shown to be associated with decreased maternal morbidity and mortality, as well as increased utilization of well child care and child immunization status.[6-13]

Most studies have found that, compared with urban populations, rural populations are on average poorer, less likely to be insured, and less educated, and that rural mothers are more likely to be younger, unmarried, and to have unintended pregnancies.[14, 15]

Results of studies evaluating the association of rural-urban category of residence with prenatal care utilization have been mixed, but the preponderance of studies has found less adequate prenatal care for rural women compared with urban women.[16-18] Demonstrated barriers to early, adequate prenatal care for rural women include fewer available local obstetric

providers, lower levels of health insurance, and the problems posed by increased distance, travel time, and limited transportation infrastructure.[19-21]

The effect of maternal geographic residence on access to prenatal care has not been fully evaluated in Oregon. Changes over time in the definition of rurality, along with multiple definitions used simultaneously by different government entities, further complicates analysis. Geographic information systems (GIS) technology is now available that can link individuals' data with information about where they live.[22]

The goal of this study was to expand the knowledge of rural-urban differences in factors affecting initiation of prenatal care in Oregon. Our aims were to describe how maternal demographics vary by geographic category of residence for women in Oregon, to determine if rural women in Oregon are less likely to access early prenatal care compared with their non-rural counterparts, and to identify factors that might contribute to this difference. We also wanted to examine whether rural women report more and/or different barriers to accessing early prenatal care, compared with their non-rural counterparts.

We hypothesized that rural women would be disadvantaged with regard to starting prenatal care in the first trimester when compared to urban women. We also hypothesized that, among women who did not start prenatal care as early as they would have liked, rural women would face more and different types of barriers compared to urban women. Finally, we predicted that category of residence would have a dose-response effect on outcomes, and that for the risk factors investigated, there would be a spectrum from the most urban to the most rural women.

METHODS

This study utilized an observational, cross sectional design based on data collected in the 2003 Oregon Pregnancy Risk Assessment Monitoring System (PRAMS), geocoded and linked to data in the Oregon Birth Certificate database.

A. Sample and Data Collection

PRAMS is a collaborative multistate surveillance project of the National Centers for Disease Control and Prevention (CDC) and state health departments, that generates state-specific population-based data on maternal attitudes and experiences.[23] In Oregon, PRAMS information is collected monthly via a stratified, random sample of approximately 200 women who gave birth to a live child in Oregon in the 60-180 days before the selection date, using birth certificates for the sampling frame. Racial and ethnic minorities are oversampled.[24]

Two to six months after delivery, the PRAMS questionnaires are mailed to the selected women. Non-responders receive a second mailing, and, if necessary, are interviewed by telephone. In 2003, 2,292 women were initially sampled, and 1,508 women responded, for a response rate of 65.8% (unweighted) or 73.8% (weighted). After the dataset is linked with the birth certificate registry and de-identified, a 3-tiered weighting scheme is applied, in order to make the data representative of Oregon as a whole. The three tiers are: "Over sampling adjustment," "Unit non-response," and "Non-coverage adjustment."[24]

B. Measurements

Determining category of residence

Our main exposure of interest was category of maternal residence on the rural-urban continuum. Although many different taxonomies have been used to achieve this, currently the most promising trend is toward expanded use of "Rural Urban Commuter Access Codes" (RUCA Codes). RUCA Codes were developed through a collaboration of the University of

Washington Rural Health Research Center (UW RHRC) and the United States Department of Agriculture Economic Research Service. US Census tracts are used to create codes that classify locales systematically, based on measures of population density, geography, and daily primary and secondary commuter flow patterns. The 33 resultant subcodes can be aggregated into super-categories in a variety of ways, as appropriate for the particular project at hand; see Table 1. [22, 25, 26]

Mothers' category of residence was determined by linking residential census tract codes from the birth certificate registry with the RUCA Census Tract Codes version 1.1 for Oregon. We used a 3-level residential categorization scheme recommended by the UW RHRC, describing locales as either (1) urban focused ("urban") (RUCA codes 1.0, 1.1, 2.0, 2.1, 2.2, 3.0, 4.1, 5.1, 7.1, 8.1, and 10.1), (2) large rural city/town ("large rural")(RUCA codes 4.0, 5.0, and 6.0), or (3) small and isolated small rural town ("small/isolated rural")(RUCA codes 7.0, 7.2, 7.3, 7.4, 8.0, 8.2, 8.3, 8.4, 9.0, 9.1, 9.2, 10.0, 10.2, 10.3, 10.4, and 10.5). [22, 25, 27]

Urban focused areas include metropolitan areas and the surrounding areas from which commuters primarily flow in; large rural areas include large towns (10,000 to 49,999 people) and their surrounding areas from which commuters flow in; and small and isolated small rural towns include towns with populations of 9,999 or less, and the surrounding areas whose residents primarily commute only to small towns. [22, 25, 27]

Determining timing and adequacy of prenatal care

The Oregon Birth Certificate collects information on the month of pregnancy in which prenatal care first began. We used these data to categorize prenatal care as early (began before the start of the 4th month of pregnancy) or late.

Determining barriers to early initiation of prenatal care

The main PRAMS questions of interest for this study were:

- Did you get prenatal care as early in your pregnancy as you wanted?

Women who answered "no" to this question then went on to answer the following question:

- Did any of these things keep you from getting prenatal care as early as you wanted? (check all that apply)
    a. I couldn't get an appointment earlier in my pregnancy
    b. I didn't have enough money or insurance to pay for my visits
    c. I didn't know that I was pregnant
    d. I had no way to get to the clinic or doctor's office
    e. The doctor or my health plan would not start care earlier
    f. I didn't have my Oregon Health Plan or Medicaid card.
    g. I had no one to take care of my children
    h. I had too many other things going on
    i. Other:_____

Because only 335 women (unweighted 23% of all respondents) reported not getting prenatal care as early as they wanted, and because there were nine options for identifying barriers, it was necessary to consolidate the barrier responses for analysis. We also evaluated the 56 "other" responses, for inclusion with responses a-h in the consolidation. We created 3 categories to consolidate the barriers by broad underlying causality: (1) barriers directly related to a woman's ability to either pay for prenatal care or have insurance that covered it ("insurance/money barriers": responses a, b, e, f, and related "other" responses); (2) barriers that were not directly related to insurance or ability to pay for prenatal care, including logistical problems such as difficulty with childcare or transportation, as well as personal or social factors that impeded accessing prenatal care, such as not wanting others to know of the pregnancy, being incarcerated, or being too busy ("social/logistical barriers": responses c, d, g, h, and related "other" responses), and (3) no barriers cited. There was some judgment involved in classifying the responses into these 3 categories; for instance, response "a" above could be interpreted in a number of ways, but we believed that the majority of underlying reasons for women choosing this response would be related to insurance or ability to pay.

Other measures

Other data derived from the PRAMS responses included timing of pregnancy recognition, history of intimate partner violence (IPV), pregnancy intendedness, household income, and language in which the survey was completed (English vs. Spanish). The PRAMS data discriminated whether a woman had experienced IPV before vs. during her pregnancy, but we consolidated these responses into dichotomous IPV: yes/no categories. Self reported household income was dichotomized as less than or equal to vs. greater than 185% of the Federal Poverty Level (185% FPL). Timing of pregnancy recognition was determined by dichotomizing the responses to the question "How many weeks or months were you when you were sure you were pregnant?" into 1st trimester recognition, yes/no. Pregnancy intendedness was determined by the responses to the question "Thinking back to just before you got pregnant, how did you feel about becoming pregnant?" Answers were dichotomized into "intended" (wanted to be pregnant sooner or then) vs. "unintended" (wanted to be pregnant later or not at any time in the future).

Information derived from the linked birth certificate registry included maternal age, maternal education, marital status, parity, timing of first visit for prenatal care, race and ethnicity, country of birth, and US census tract of residence. Maternal age was categorized as <18, 18-34, and >34 years. Maternal education was categorized as <12th grade, 12th grade and up to 3 years of college, and more than 3 years of college. Parity was dichotomized as first born or subsequent birth. Maternal birthplace was dichotomized to either US or foreign born. Data from the race and ethnicity variables on the birth certificate (including Hispanic or not Hispanic) were consolidated into 5 categories: Alaskan Indian/American Native (AI/AN), African American, Asian/Pacific Islander, Hispanic, and non-Hispanic White.

C. Statistical Analysis

Data management and recoding were done using SPSS v.11.0. Because of the complex PRAMS sample design with its stratified weighted sampling procedure, all statistical analyses were based on weighted data and conducted in SAS-callable SUDAAN. Statistical analyses included univariate, bivariate, stratified, and logistic regression. The Cochran-Mantel-Haenzel test of association (CMH) is in the family of chi-square tests, and is appropriate when looking at contingency tables greater than 2x2, particularly when assessing effects of a third variable on the relationship between 2 variables. The CMH looks at the individual chi-square associations for all possible underlying 2x2 associations, and then pools the individual statistics to obtain an overall association across all the categories.

Our primary exposure of interest was category of maternal residence. We looked at the association of this exposure with 2 different outcome variables: late initiation of prenatal care, and barriers to initiation of prenatal care. We explored the characteristics of the sample population, determining the CMH test of association and its associated p-value across the three geographic categories of residence. We conducted bivariate logistic regression analysis to estimate the odds ratios and 95% confidence intervals for the association between individual maternal characteristics and late initiation of prenatal care.

For our multivariate regression analysis of the association between categories of residence and late prenatal care, the potential confounders we evaluated included age, education, marital status, pregnancy intendedness, Hispanicity, 185%FPL, and categories of barriers. We evaluated for potential interactions between category of residence and the other independent variables in the model, using the CMH test with a significance level of $p<.05$, and found no significant interactions. We adjusted our final regression model for maternal age, marital status, education, Hispanicity and pregnancy intendedness, because these variables were associated

with both our exposure and our outcome, and changed the crude odds ratios for category of residence by at least 10%. We also included 185%FPL because it changed the crude odds ratio by more than 10%, and category of barriers, because of intuitive relevance.

We built a multivariate regression model to determine which maternal factors together would best predict late initiation of prenatal care. Review of the previous literature on factors affecting timing of initiation of prenatal care supported initial inclusion of the following covariates, which were statistically significant in our bivariate analysis: maternal age, marital status, race/ethnicity, family income relative to 185% of the FPL, maternal education attainment, language in which questionnaire was completed (English vs. Spanish), and intendedness of pregnancy. We also included categories of barriers to prenatal care initiation. We re-ran the model, substituting Hispanicity for race/ethnicity. We evaluated for potential interactions between marital status and intendedness of pregnancy, between maternal age and poverty level, and between Hispanicity and poverty level, using the CMH test with a significance level of $p<.05$, and found no significant interactions. We subsequently removed those risk factors that had no or minimal significance in the multivariate model, using a backward elimination strategy to select the best regression model. Our final model included 4 covariates: types of barriers, marital status, Hispanicity, and $\leq$185%FPL.

We examined the association of category of residence with barriers to initiation of prenatal care in several different ways. We looked for association with each individual barrier, but because of small cell counts we also looked at number of barriers cited (0,1, 2, or $\geq$ 3 barriers cited). Because women could cite multiple barriers, we also analyzed the 3 categories of barrier responses by dividing respondents into 4 mutually exclusive categories: (1) women who only cited insurance/money barriers, (2) women who only cited social/logistical barriers, (3) women who cited both types of barriers, and (4) women who cited no barriers. Associations

between these categories of barriers and maternal category of residence, as well as other maternal sociodemographic and behavioral factors, were determined by CMH.

Table 1. Rural-Urban Commuting Area Codes (RUCA Codes)

1 Metropolitan area core: primary flow within an urbanized area (UA)
1.0 No additional code
1.1 Secondary flow 30% to 50% to a larger UA
2 Metropolitan area high commuting: primary flow 30% or more to a UA
2.0 No additional code
2.1 Secondary flow 30% to 50% to a larger UA
3 Metropolitan area low commuting: primary flow 5% to 30% to a UA
3.0 No additional code
4 Micropolitan area core: primary flow within an Urban Cluster of 10,000 to 49,999 (large UC)
4.0 No additional code
4.1 Secondary flow 30% to 50% to a UA
4.2 Secondary flow 10% to 30% to a UA
5 Micropolitan high commuting: primary flow 30% or more to a large UC
5.0 No additional code
5.1 Secondary flow 30% to 50% to a UA
5.2 Secondary flow 10% to 30% to a UA
6 Micropolitan low commuting: primary flow 10% to 30% to a large UC
6.0 No additional code
6.1 Secondary flow 10% to 30% to a UA
7 Small town core: primary flow within an Urban Cluster of 2,500 to 9,999 (small UC)
7.0 No additional code
7.1 Secondary flow 30% to 50% to a UA
7.2 Secondary flow 30% to 50% to a large UC
7.3 Secondary flow 10% to 30% to a UA
7.4 Secondary flow 10% to 30% to a large UC
8 Small town high commuting: primary flow 30% or more to a small UC
8.0 No additional code
8.1 Secondary flow 30% to 50% to a UA
8.2 Secondary flow 30% to 50% to a large UC
8.3 Secondary flow 10% to 30% to a UA
8.4 Secondary flow 10% to 30% to a large UC
9 Small town low commuting: primary flow 10% to 30% to a small UC
9.0 No additional code
9.1 Secondary flow 10% to 30% to a UA
9.2 Secondary flow 10% to 30% to a large UC
10 Rural areas: primary flow to a tract outside a UA or UC
10.0 No additional code
10.1 Secondary flow 30% to 50% to a UA
10.2 Secondary flow 30% to 50% to a large UC
10.3 Secondary flow 30% to 50% to a small UC
10.4 Secondary flow 10% to 30% to a UA
10.5 Secondary flow 10% to 30% to a large UC
10.6 Secondary flow 10% to 30% to a small UC

From US Department of Agriculture Economic Research Service 2000 Rural-Urban Commuting Area Codes[25]

RESULTS

Characteristics of population by category of residence

Overall, women from the large rural areas were more likely to have risk factors for late prenatal care, compared with women in either the urban or the small/isolated rural areas (Table 2). Compared with women in both urban and small/isolated rural areas, women from large rural areas were more likely to be under 18 years old, unmarried, have less than 12 years of education, and have an unintended pregnancy. Compared with women in the other two categories of residence, women from urban areas had the largest percent of mothers who were older than 34 years and who completed more than 3 years of college, and the lowest percent of mothers who were White, who were born in the USA, and who completed the questionnaire in English. Tobacco use was more common in the women from the small/isolated rural areas, compared with women in urban or large rural areas.

Association of category of residence and other maternal variables with late initiation of prenatal care

In the unadjusted (crude) analysis there was no statistically significant association between category of residence and late initiation of prenatal care. With urban residence as the reference, for large rural the odds ratio (OR) was 0.9 (95% CI 0.5 to 1.6) and for small/isolated rural, OR = 0.8 (95% CI 0.5 to 1.5) (Table 3). Other maternal characteristics found to be significantly associated with an increased risk of late initiation of prenatal care in unadjusted analysis included: age less than 18 years (OR = 6.6, 95% CI 2.4 to 18.2), unmarried status (OR =3.4, 95% CI 2.3 to 5.2), less than 12^{th} grade education (OR = 4.5, 95% CI 2.4 to 8.4), race/ethnicity either AI/AN (OR = 2.2, 95% CI 1.5 to 3.2), or Hispanic (OR = 2.0, 95% CI 1.4 to 2.8), completion of the survey in Spanish (OR =2.1, 95% CI 1.5 to 3.0), unintendedness of pregnancy (OR =1.9, 95% CI 1.3 to 2.9), and household income less than 185% of the Federal Poverty Level (OR =2.9, 95% CI 1.8 to 4.7). All 3 categories of barriers to prenatal care were

significantly associated with late prenatal care, with the strongest association for social/logistical barriers only (OR = 5.4, 95% CI 2.6 to11.4), followed by both social/logistical and money/insurance barriers together (OR =3.9, 95% CI 1.7 to 8.8), and money/insurance barriers only (OR =3.4, 95% CI 2.0 to 6.0).

After adjusting for maternal characteristics, the absence of an association between category of residence and late prenatal care persisted, although the odds ratio for the large rural category did change (OR = 0.7, 95% CI 0.3 to 1.4). (Data not shown)

In our second multivariate logistic regression model, the variables which together best predicted late initiation of prenatal care were: unmarried status (OR 2.09, 95% CI 1.32 to 3.32), maternal Hispanicity (OR 1.51, 95% CI 1.01 to 2.25), $\leq$185% FPL (OR 1.73, 95% CI 1.02 to 3.01), and all categories of barriers. In this adjusted analysis, compared with women with no barriers to initiating prenatal care, women with the highest risk of late initiation of prenatal care were those citing only social/logistical barriers (OR 4.18, 95% CI 1.74 to 10.20), followed by women with only money/insurance barriers (OR 3.04, 95% CI 1.66 to 5.55) and women with both types of barriers (OR 2.64, 95% CI 1.05 to 6.60). (Table 3)

Category of residence and barriers to care

Frequencies of each barrier to prenatal care cited are shown in Table 4. We found no association between category of residence and barriers to initiation of prenatal care, whether we looked by individual barriers, number of barriers (1, 2, or $\geq$3), or categories of barriers (CMH 2-tailed p-value =0.96) (Table 5). Within each category of residence, approximately 10% of women cited money/insurance barriers only, approximately 5% cited social/logistical barriers only, and approximately 4.5% cited both types of barriers.

Factors that were significantly associated with category of barriers included recognition of the pregnancy in the first trimester, maternal age, maternal education, marital status, maternal

race, pregnancy intendedness, and maternal household at or below 185% federal poverty level (Table 5). Within the subset of the study population who cited any barriers, women were more likely to cite money/insurance barriers alone than they were to cite social/logistical barriers alone or both types of barriers together. In every category of barrier, approximately three quarters of the women were at or below the federal poverty line, compared with half of the women who cited no barriers. There were differences in the likelihood of other risk factors across the categories of barriers. Compared with women citing the other categories of barriers, women citing only the social logistical barriers were more likely to be less than 18 or greater than 34 years old, to be unmarried, and less likely to have recognized the pregnancy in the first trimester or to have completed 12th grade. Compared with women citing the other categories of barriers, women citing only the social/logistical barriers were more likely to be American Indian/Alaska Native or Hispanic, and less likely to be White.

Table 2. Sociodemographic Characteristics of Oregon Mothers by Category of Residence, PRAMS 2003

Variable	Urban N = 1011 No. (%)*	Large Rural N = 211 No. (%)*	Small/Isolated Rural N = 219 No. (%)*
Maternal age			
<18	43 (1.3)	7 (4.3)	10 (2.4)
18-34	830 (83.0)	194 (90.0)	184 (85.8)
>34	138 (15.7)	10 (5.7)	25 (11.8)
Marital Status			
Married	650 (72.3)	121 (61.5)	146 (81.3)
Not Married	361 (27.7)	90 (38.5)	73 (18.7)
Maternal education			
<12th grade	242 (15.6)	56 (18.9)	63 (16.9)
12th grade and up to 3 yrs of college	523 (55.8)	120 (64.6)	122 (63.2)
>3 yrs college	237 (28.6)	32 (16.7)	31 (19.9)
Race/Ethnicity			
AI/AN	103 (1.1)	47 (2.0)	58 (2.5)
African American	181 (2.9)	9 (0.6)	13 (0.8)
A/PI	236 (6.8)	29 (3.4)	19 (2.2)
Hispanic	266 (18.2)	68 (18.7)	69 (18.2)
White	224 (70.7)	57 (73.8)	60 (76.3)
Questionnaire Language			
English	810 (87.4)	180 (91.9)	176 (89.2)
Spanish	188 (12.6)	31 (8.1)	42 (10.8)
Maternal Birthplace			
Not USA	440 (23.1)	63 (14.0)	66 (16.0)
USA	571 (76.9)	148 (86.0)	152 (84.0)
Pregnancy Intendedness			
Unintended	409 (36.8)	94 (45.9)	92 (38.9)
Intended	583 (63.2)	116 (54.1)	122 (61.1)
Tobacco use during pregnancy			
No	918 (91.5)	179 (84.8)	184 (79.7)
Yes	84 (8.5)	31 (15.2)	32 (20.3)
≤185% FPL?			
Yes	595(51.4)	135 (62.4)	145 (59.7)
No	355 (48.6)	62 (37.6)	63 (40.3)
Got PNC as early as wanted?			
No	237 (19.7)	42 (21.6)	46 (18.2)
Yes	745 (80.3)	161 (78.4)	167 (81.8)

* No. is the unweighted number in sample; % is the weighted, column percent
Some column numbers do not add to total due to missing data.
PNC= prenatal care AI/AN=American Indian/Alaska Native A/PI=Asian/Pacific Islander
FPL= Federal Poverty Level

TABLE 3. Associations of Maternal Characteristics with Late Initiation of Prenatal Care

Variable	Without 1st tri. PNC N=327 No. (%)*	With 1st tri. PNC N=1169 No. (%)*	Crude OR (95% CI)	Adjusted** OR (95% CI)
Category of residence				
Urban	198 (68.6)	804 (65.7)	1.00 ref	
Large rural	53 (16.1)	158 (16.8)	0.9 (0.5, 1.6)	
Small/ isolated rural	48 (15.3)	170 (17.5)	0.8 (0.5, 1.5)	
Number of Barriers Cited				
1 barriers	87 (57.3)	110 (49.9)	1.00 ref	
2 barriers	37 (19.8)	44 (31.8)	0.5 (0.2, 1.3)	
≥3 barriers	31 (23.0)	25 (18.3)	1.1 (0.4, 2.9)	
Barriers to PNC				
None	172 (61.2)	994 (86.2)	1.00 ref	1.00 ref
Money/Insurance only	70 (18.6)	93 (7.6)	3.4 (2.0, 6.0)	3.0 (1.7, 5.6)
Social/Logistical only	52 (11.2)	47 (2.9)	5.4 (2.6, 11.4)	4.2 (1.7, 10.0)
Money/Insurance AND Social/Logistical	33 (9.0)	35 (3.3)	3.9 (1.7, 8.8)	2.6 (1.0, 6.6)
Maternal age				
<18	24 (7.4)	40 (1.3)	6.6 (2.4, 18.2)	
18-34	277 (80.7)	976 (85.3)	1.1 (0.6, 2.0)	
> 34	26 (11.9)	153 (13.4)	1.00 ref	
Marital Status				
Married	150 (49.8)	801 (77.3)	1.00 ref	1.00 ref
Not Married	177 (50.2)	368 (22.7)	3.4 (2.3, 5.2)	2.1 (1.3, 3.3)
Maternal education				
<12th grade	128 (29.8)	249 (13.3)	4.5 (2.4, 8.4)	
12th grade and up to 3 years of college	165 (56.5)	630 (59.0)	1.9 (1.0, 3.5)	
>3 years college	28 (13.8)	278 (27.7)	1.00 ref	
Race/Ethnicity				
AI/AN	66 (2.5)	162 (1.3)	2.2 (1.5, 3.2)	
African American	41 (2.2)	166 (2.1)	1.2 (0.8, 1.9)	
A/PI	50 (4.8)	242 (5.6)	1.0 (0.7, 1.5)	
Hispanic	117 (27.3)	299 (16.3)	2.0 (1.4, 2.8)	
White	53 (63.2)	298 (74.1)	1.00 ref	
Mother Hispanic				
Yes	117 (27.3)	299 (16.4)	1.9 (1.4, 2.7)	1.5 (1.0, 2.2)
No	210 (72.7)	868 (83.6)	1.00 ref	1.00 ref
Questionnaire Language				
English	241 (80.8)	964 (89.9)	1.00 ref	
Spanish	83 (19.2)	191 (10.1)	2.1 (1.5, 3.0)	
Pregnancy intended?				
No	174 (50.9)	438 (34.9)	1.9 (1.3, 2.9)	
Yes	151 (49.1)	706 (65.1)	1.00 ref	
≤185% FPL?				
Yes	246 (74.5)	664 (50.4)	2.9 (1.8, 4.7)	1.7 (1.0, 3.0)
No	55 (25.5)	441 (49.6)	1.00 ref	1.00 ref

* No. is the unweighted number in sample; % is the weighted column percent
Some column numbers do not add to total due to missing data.
**Adjusted for: category of residence, barriers, marital status, Hispanicity, and ≤185% FPL
PNC= Prenatal Care; FPL=Federal Poverty Level; AI/AN=American Indian & Alaska Native
A/PI= Asian/Pacific Islander

Table 4. Frequencies of Barriers to Prenatal Care Cited, Among Respondents Who Did Not Start Prenatal Care as Early as They Wanted (*N* = 335)

Barrier Cited	No. (%)*
I couldn't get an appointment earlier in my pregnancy	94 (31.4)
I didn't have enough money or insurance to pay for my visits	110 (32.5)
I didn't know that I was pregnant	108 (27.1)
I had no way to get to the clinic or doctor's office	29 (8.2)
The doctor or my health plan would not start care earlier	33 (11.0)
I didn't have my Oregon Health Plan or Medicaid card.	83 (21.7)
I had no one to take care of my children	10 (3.4)
I had too many other things going on	35 (10.4)
Other:_____	56 (14.5)

*No. is the unweighted number in sample; % is the weighted column percent
Respondents could indicate more than one choice, so responses are not mutually exclusive.

Table 5. Association of Maternal Characteristics with Categories of Barriers to Prenatal Care

	Money/ Insurance Barriers only N=164 No. (%)*	**Social/ Logistical Barriers only** N=101 No. (%)*	**Money/ Insurance AND Social/ Logistical Barriers** N=70 No. (%)*	**No Barriers** N=1173 No. (%)*	**p-value ****
Category of Residence					0.96
Urban	117 (67.8)	64 (63.6)	54 (70.8)	776 (66.2)	
Large rural	20 (16.2)	14 (22.1)	7 (11.1)	170 (16.6)	
Small /isolated rural	20 (16.0)	19 (14.3)	8 (18.1)	172 (17.2)	
Recognized Pregnancy in 1st trimester					<.001
No	26 (17.3)	42 (51.3)	28 (31.0)	104 (7.3)	
Yes	134 (82.7)	54 (48.7)	40 (69.0)	1001 (92.7)	
Maternal age					<.001
<18	5 (4.6)	18 (11.6)	1 (0.2)	42 (1.8)	
18-34	145 (88.7)	75 (73.0)	67 (95.6)	974 (83.9)	
≥ 35	14 (6.7)	8 (15.3)	2 (4.2)	157 (14.3)	
Maternal education					.004
<12th grade	42 (20.5)	41 (37.9)	24 (21.2)	278 (14.7)	
12th grade & up to 3 yrs of college	95 (60.4)	50 (49.9)	40 (69.9)	614 (58.1)	
≥4 yrs college	24 (19.1)	9 (12.3)	6 (8.9)	267 (27.2)	
Marital Status					<.001
Married	91 (63.2)	38 (37.6)	31 (49.0)	795 (76)	
Not Married	73 (36.8)	63 (62.4)	39 (51.0)	378 (24.0)	
Race/Ethnicity					<.001
AI/AN	26 (1.9)	28 (4.3)	11 (1.8)	164 (1.4)	
African American	31 (3.5)	16 (3.7)	17 (4.1)	144 (1.8)	
A/PI	36 (6.9)	19 (7.6)	7 (2.9)	233 (5.3)	
Hispanic	37 (16.8)	26 (26.6)	20 (19.4)	339 (18.2)	
White	34 (70.9)	12 (57.8)	15 (71.8)	291 (72.8)	
Pregnancy intended?					.003
No	79 (46.2)	66 (58.6)	39 (61.9)	438 (34.8)	
Yes	82 (53.8)	33 (41.4)	30 (38.1)	714 (65.2)	
≤185% FPL?					<.001
Yes	119 (76.1)	73 (74.4)	56 (75.6)	669 (50.0)	
No	37 (23.9)	17 (25.6)	10 (24.4)	433 (50.0)	

* sample numbers and weighted, column percents **based on CMH test (2-tailed)
Some column numbers do not add to total due to missing data.
PNC= Prenatal Care; FPL=Federal Poverty Level; AI/AN=American Indian & Alaska Native
A/PI= Asian/Pacific Islander

DISCUSSION

Using the data from a population-based survey and linked birth certificate records, we found there was no significant association between geographic category of maternal residence and late initiation of prenatal care, or between category of maternal residence and types of barriers to initiation of prenatal care. Nor did our findings support our hypothesis that we would find a "dose effect" of category of residence, and that many of the risk factors investigated would be most strongly associated with the more rural, isolated areas. It appears instead that women in the middle category (large rural) have a higher proportion of risk factors for late prenatal care.

Characteristics of Study Population, by Category of Residence

In our analysis of the study population by category of residence, our findings are consistent with those of others: women in non-urban areas are more likely to be poor, less educated, and White.[28-30]

We found important differences between our 2 categories of non-urban women, groups that have in the past frequently been combined into a single "rural" category. Our findings suggest that there is a clustering in the large rural areas of a number of maternal risk factors known to be associated with poor perinatal outcomes, including young age, unmarried status, low level of educational attainment, and higher rates of unintended pregnancy. This finding is supported by that of Hulme and colleagues,[14] who found that, while rural women traveled the greatest distances for care, rural-adjacent women had the most risk factors, including youth, low education level, low rates of marriage, and low rates of insurance. They concluded that by using 3 levels instead of the usual two, they had identified two distinct groups of non-urban women with different maternal health care needs.

Category of Residence and the Risk of Late Prenatal Care Initiation

Our results suggest that among women in Oregon, late initiation of prenatal care is not significantly affected by category of maternal residence. While most studies have indicated a rural disadvantage in initiating and utilizing prenatal care,[16-18, 31] some researchers have reported findings similar to ours.[5, 20, 29] An analysis of Oregon's 2001 PRAMS data used a dichotomous rural/urban taxonomy at the county level for classifying maternal category of residence, and found no statistically significant differences in timing of prenatal care initiation between rural and urban women.[29] Alexy's 1997 study comparing rural and urban women accessing prenatal care at public health clinics found that both rural and urban women received inadequate prenatal care, and hypothesized that short clinic hours and logistics such as transportation and childcare may have contributed to underutilization.[5] An analysis of 1999 Utah PRAMS data found that when comparing rural and urban women, there was no significant difference in the adequacy of the number of prenatal visits received, but that urban women were almost 3 times as likely to receive inadequate care due to late entry.[20]

Most researchers have reported lower rates of prenatal care utilization among rural women compared with their more urban counterparts.[16-18, 31] Larson et al. analyzed records of 11.06 million U.S. births between 1985 and 1987; among nonmetropolitan residents they found both increased levels of late prenatal care and greater risk of post-neonatal mortality, although not of increased risk of low birth weight or neonatal mortality.[16] Nesbitt and colleagues looked at Washington State birth certificates linked with hospital discharge abstracts to study 29,809 births to mothers residing in rural areas. They measured access to care by categorizing rural areas as those where more than two thirds of the women left for care ("poor access"), compared with areas where less than one third left for care. They found women from poor access areas to be at significantly greater risk of receiving inadequate prenatal care, as measured by

Kotelchuck's Adequacy of Prenatal Care Utilization Index (APNCU).[17] An analysis done in Washington state used RUCA codes to stratify the 2000 population; they found that compared with women in urban areas, women who live in the more rural areas were less likely to begin prenatal care in the first trimester.[18] In 2002, Baldwin and colleagues found that in a nationwide sample of American Indian/Alaskan Native mothers, rural dwelling women were significantly more likely to receive inadequate prenatal care.[31]

This inconsistent finding of an association between category of residence and initiation of prenatal care may be at least in part due to differences in the rural taxonomies used in different studies, as well as different study designs and changes in the population over time, but may also reflect genuine differences in the nature of rural populations and community characteristics across the nation.

Consistent with the work of other researchers, we found increased risk of late initiation of prenatal care among the mothers who were unmarried, Hispanic, and poor.[20, 21]

Category of Residence and Barriers to Initiation of Prenatal Care

Our finding that, contrary to our expectation, distribution of barriers across the categories of residence were remarkably similar, suggests that for Oregon women, barriers to initiating prenatal care are a geographically global problem. There has been a paucity of research looking at the effects of geography on specific barriers to accessing prenatal care. Analysis of multi-state PRAMS data from 1997 found that 56% of the women reporting delayed or no prenatal care wanted to begin prenatal care earlier than they did;[2] reported reasons for not receiving care earlier were analyzed by race/ethnicity, age, and method of payment for prenatal care, but not by geographic location. Similarly, the previously cited analysis of 1999 Utah PRAMS data also looked at barriers to early prenatal care, noting the top 3 barriers reported were lack of money,

not recognizing the pregnancy, and being too busy; unfortunately these barriers were not analyzed for association with category of residence.[20]

Our results support the findings of others that barriers to prenatal care are strongly linked with poverty.[21, 32, 33] It is striking that across all the barrier categories, close to 75% of respondents were below 185% of the federal poverty level, compared with 50% of the respondents who cited no barriers.

Our finding that of all the maternal characteristics investigated, social/logistical barriers had the strongest association with late initiation of prenatal care, is consistent with that of other researchers.[21,34] Braveman and colleague's 2000 study of barriers to prenatal care among insured low income women in California found that the two most significant non-insurance barriers were unintended pregnancy and no schooling beyond high school.[21] A similar study in Europe found that, after adjusting for confounders, perceived financial difficulty was not an obstacle to obtaining prenatal care, and concluded that sociocultural barriers, while difficult to address, remain significant barriers.[34]

Limitations

Both data sources used for this analysis have inherent limitations. Many studies in recent years have looked at the validity and reliability of birth certificate data.[35-45] While many studies have found that birth certificate data is reasonably good for certain variables, including maternal age, parity, marital status and race,[35, 43, 45] most studies have cast doubt on their use for measures of prenatal care utilization, particularly with regard to number of visits and exact dates of initiation.[36, 38, 42, 44, 46] Birth certificate data have been found to both over-report and under-report number of prenatal care visits. Several researchers conclude that it is reasonable to use birth certificate data to determine trimester in which care began.[42, 45] Because of these concerns regarding the reliability and validity of some variables from birth certificate data, we did not

look at other measures of prenatal care utilization, such as the Kotelchuck APNCU Index. A different study design, utilizing medical chart review, would allow such an analysis. If our dependence on birth certificate data to determine timing of initiation of prenatal care led to misclassification, its effect on our findings would be predicated on whether the misclassification was differentially associated with category of residence. No research has specifically addressed this question, but the Washington State Department of Health's Center for Health Statistics monitors quality of birth certificate data from every hospital in the state, and reports that in 2005 and 2006, birth certificates from larger hospitals in Washington State had on average more missing data than those from smaller hospitals; this suggests that birth certificated data from births in more rural hospitals may be more accurate.[47] If, for instance, the smallest, most rural hospitals more accurately capture the timing of the first prenatal care visit, while urban hospitals systematically overestimate the number of women beginning care in the first trimester, our study could have failed to find a true rural advantage in starting prenatal care.

The PRAMS sample size may have limited our ability to identify associations between our outcomes of interest and smaller strata, such as between residence in the small/isolated rural areas and having both money/insurance and social/logistical barriers (n=8). Similarly, while our stratified analysis did not detect any interactions between category of residence and the maternal variables investigated, it is possible that small cell counts limited our ability to detect a true interaction. Future researchers might consider combining two or more years of PRAMS data, or combining data from several states in the same region, to explore these ideas further.

Finally, a limitation exists with regard to the way the PRAMS survey elicits information about barriers to starting prenatal care. Because this question is only answered by women who indicate they did not get prenatal care as early as they wanted, it fails to collect information from the women who for one reason or another did not want or choose to start prenatal care in

the first trimester. Such reasons could include personal or cultural preconceptions about prenatal care, lack of knowledge of recommended standards, failure to recognize the pregnancy in the 1st trimester, and desire to conceal the pregnancy. In this study, over half of the women (57.6%) who did not start prenatal care in the first trimester nevertheless indicated that they had started prenatal care as early as they had wanted, and therefore did not go on to answer questions about barriers. Conversely, among women who did start prenatal care in the first trimester, 13.7% indicated that they did not get prenatal care as early as they had wanted, and so did go on to answer the barrier question. Our findings were similar to those of Sarnoff and Adams, who analyzed discordance between women's assessment of the adequacy of the timing of their prenatal care entry and the standard of first trimester initiation. They found that among the women with untimely care, 57% were satisfied with the time of care initiation, and that this discordance was associated with African American race and Hispanic ethnicity.[48]

Policy implications

To date, Oregon's maternal and child health programs have overlooked geography as a consideration in planning; targeting of services has been limited to focusing on specific age groups and an emphasis on addressing racial/ethnic disparities. Our finding that many of the risk factors associated with late initiation of prenatal care were clustered in the middle category of residence (large rural city/town) suggests that outreach needs to be intensified or programs modified to reach women living in these areas. Similarly, our finding that tobacco use during pregnancy was highest in the women in the small/isolated rural areas suggests a new geographic focus of activity for Oregon's Tobacco Prevention and Education Program.

With regard to barriers to prenatal care, in the past most attention has focused on programs to reduce money/insurance barriers, such as Medicaid expansion and presumptive eligibility.[49-51] In this study we found, however, that women with social/logistical barriers were at the greatest

risk for late initiation of prenatal care. Furthermore, we found that women who identified social/logistical barriers to prenatal care were more likely to be less than 18 years old, less educated, and unmarried, factors that in themselves have been found to be associated with late initiation of prenatal care.[20, 21, 32, 33] Some social/logistical barriers are amenable to policy changes that could improve access to prenatal care after a pregnancy has been recognized (e.g., difficulty taking time off from work, incarceration, lack of childcare). However, many of the social/logistical barriers, such as desire to keep the pregnancy secret, denial, or not recognizing the pregnancy early, are linked to unintended pregnancy and ambivalence about the pregnancy. It is clear that programs designed to reduce rates of late initiation of prenatal care will need to address factors affecting women before pregnancy, including education and services to help women plan and time their pregnancies. This recommendation parallels the recent call at the national level for a focus on preconceptional, as opposed to prenatal, health care.[52-54]

Although we found that rural women did not initiate prenatal care later than non-rural women, continued vigilance may be indicated; many researchers and policy makers have raised the concern of a declining obstetrical workforce in rural America.[17, 55, 56] The Oregon Health Science University Office of Rural Health has been tracking Oregon's physician workforce since the mid 1970s; their 2004 analysis of the rural workforce reveals a steady decline in physicians willing to practice in rural Oregon. A 2002 survey of practitioners in Oregon found that practice location outside of the metropolitan area predicted both having already stopped providing obstetrical care, and planning to stop.[57]

Our findings suggest that for the moment we may have gone as far as we need to in Oregon to address geographic inequities in access to prenatal care. However, Oregon's current

rate of 81 percent for early initiation of prenatal care falls significantly short of the Healthy People 2010 goal of 90 percent.[1] There is clearly room for improvement for Oregon's mothers, regardless of where they live.

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